THE NEXT WAVE OF BIOTECHNOLOGY:

WILL THE CREST SUPPORT THE WEIGHT OF SUCCESS?

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(Remarks As Prepared)

Thank you very much, Dr. Ho, for the gracious introduction. It is an honor for me to be here today – to meet friends, former colleagues, and people that I have admired for many years.

I can't tell you how very much it means to me, as a scientist, to have spent some time here with ASPB colleagues, sharing some of the excitement and passion that drives us as scientists, and the commitment to making lives better for people around the world through the work that we do. I wish time would have permitted me to be here for a longer period.

I haven't been in Washington all that long, but I can tell you that it's sometimes hard to keep this passion, this drive, foremost in my mind when my

days are filled with meetings and my email is filled with the many details of running a Federal agency. Science has always offered me the opportunity to step back from considering other challenges that came with the roles in which I've found myself: providing a change of focus from policy and financial decisions to the hard core intrigue of how molecules function to effect phenotype and adaptation to environment, and trying to use that knowledge to improve agriculture and ultimately the lives of those that science must serve.

The capability to make the leap from science to policy has never been more important to me or to the job that the President has asked me to do as Director of the National Institute of Food and Agriculture. It is clear to even the most casual observer of science that we are, as a recent editorial in the journal *BioScience* notes, in the Age of Biology. Biotechnology, genomics, nanotechnology, data and knowledge management, and much more: clearly, we are riding the crest of a profound era of science that is characterized by understanding the basic mechanisms of life, of natural systems, and the profound consequences of human endeavor in those systems. And when you're on the crest of the wave in your science it can be a real head rush, one that takes you beyond the needs of the world's peoples to the ethereal desire for knowledge for knowledge's sake. I urge you to look into the reasons for the research that you do and find the time, make the effort, to either use the knowledge, or pass the knowledge to others, to address the needs of society.

Many of you here have made a point of reminding me of the importance of fundamental discovery to agriculture: You can be assured that I am well aware that this is the case. My own research career has included highly

fundamental research as well as biotechnology. Nevertheless, as a small agency, one that currently has little flexibility in its budget, NIFA must make its choices of how much support will be devoted to discovery, or foundational, research and how much on projects that embrace basic and translational research, education and extension outreach to agricultural communities. I will continue to request your input as we prioritize the many possible areas on which to focus, so that in the end we can achieve measurable outcomes for American and global agriculture in the short to mid-term, while we also support research that ensures the success of American agriculture into the future. That too, can take you to the crest of knowledge that satisfies the desire to serve society.

When one is on the crest of a wave in the sea, or riding the powder of the mountains, you often don't see the rocks and sea churn, or the bumps and cliffs that lie beneath. And believe me, there is turmoil, there are reefs, and there are rocks underneath the crest of this "Next Wave of Biotechnology" that we are experiencing. The churn involves both how science will be done, and how the products of the knowledge that might be delivered through biotechnology will be regulated, distributed, controlled.

As many of us know, the first exciting wave of biotechnology – that which promised us disease and pest resistant crops, abundant foods with fewer chemical inputs and better environmental stewardship – slowed to a crawl as the realities of product development and a regulatory burden made it difficult for those of us in academic science and in the private sector to deliver on the promises of the science of the early '80s and through the end of the century.

In the current decade we are coming to grips with the reality that science must focus on solving the 'grand societal challenges' – however you define them, that we face as a global society. Simultaneously we recognize that the contexts of contemporary biology are completely changing the way we do science. As the recent NAS report on "A New Biology for the 21st Century" points out, science will be increasingly interdisciplinary and team-driven rather than individual-investigator driven. Moreover, the work we do in biology will be increasingly cross-sector: Federal, state, university, corporate, non-profit, wherever the appropriate synergies exist.

This is sort of churn and turmoil that I referred to earlier. As we at NIFA have been working to re-orient the competitive grants programs around these new ways of doing business, we've run straight into the blunt reality that some of the things that wish to accomplish do not fit well with our current way of funding science or the expectations of the research community. Our research in the past has been heavily investigator focused – we changed that in 2010 and asked for more interdisciplinary teams to address larger challenges. Going forward, we will establish a 30/70 split in our funding, with 30 percent being traditional principal investigator grants and 70 percent devoted to team efforts. I'll say more about what those teams need to include in a moment.

This change in how research will be done may have profound implications for the way universities reward success, establish salaries, and grant tenure. Typically, tenure does not recognize the tremendously valuable contributions of team members, junior or senior. It usually recognizes principal investigators, and independence of thought. In many of our colleges and universities tenure

tends to reward research discovery and innovation in the lab more than applied research, education, and extension activities. We have to find a way to ensure that teamwork is rewarded in the tenure process.

And we need to recognize – here in this room, in our grant writing and proposal preparation, and in our tenure processes -- ALL of the teamwork that goes into the larger cross disciplinary grants. Research at USDA and in agriculture in general is a continuum from foundational, basic research at the lab bench; to applied research in the field and greenhouse; to translational research that explains to farmers, foresters, and others what our research means for them; and educational work to ensure that our research findings are available to the next generation of scientists, and that they inform the national conversations about science. These concerns have also played a role in some of the changes that are taking place at the NIH and to a lesser degree at the NSF. Outcomes, in this case the linking of discovery science to people's lives, do make a difference: the American people, including Congress, expects outcomes.

The successful teams that we are looking to support at NIFA will have strong components ACROSS the spectrum of research and education. They will conduct the best science possible, hand it off to other team members for further development and field work, and will involve extension and research communicators in getting the research findings into the hands of the production communities, and the public: Policymakers and decision leaders will learn of the goals of our projects and the outcomes that they bring.

This last point is a very important one – we need to have our research inform the conversations that take place in our state and federal legislative

chambers, in community groups, in advocacy organizations, and in the media. One of the rocks lurking under the crest of our "next wave" is public adoption of the new products being developed through biotechnology.

As a scientist in the U.S. Administration, I am very comfortable in my knowledge that science can and does form the foundation for this Administration's policies and programs. But we live in a democracy, and the ground rules in a democracy dictate that public policy is decided by the public *writ* widely. Science in the U.S. is a social enterprise, and the decisions about what technologies are appropriate and acceptable are societal, not purely scientific decisions. These decisions about science are influenced by many factors beyond research, and the relationship between science and the public can be a tense one – especially as viewed through the lens of the media! And media receives its inputs from many disparate sources and fuels the flames of discord, purposefully or naively.

Society will always have other factors to consider when looking at new scientific findings. Religion, politics, education, and a multitude of other things influence the public. We do not live in a vacuum; we cannot remove these outside influences.

But we can help the public understand the role of research in their lives without asking them to cede the decision making about what they find acceptable to scientists alone. I learned this in spades recently from a USDA Facebook article on research that was funded by NIFA.

Researchers at Purdue University recently reported on the use of genes from yeast to elucidate an important pathway involving degradation of tissues in tomato fruit with a goal to extend their shelf life. Researchers have for more than 20 years been working on this problem and we have yet to bring a long-shelf-life tomato improved through genetic engineering to broad cultivation. The study from Purdue University, conducted by Avtar Handa and colleagues, was an interesting and neat little research finding that we were proud to feature on the USDA Facebook page. This is not the first work by Dr. Handa on this topic – but is a notable advance nonetheless.

This story caused an online uproar. Many complained that the best tomatoes are out of their garden and not genetically engineered. Others expressed fears that the yeast genes would provoke their yeast allergies. Most of the comments were more generic about how scientists should stop "messing with" our vegetables. Needless to say, most of the commentators, and the general public, didn't understand that the tomato cultivars in their backyards already are a product of plant breeding – whether it was done in a lab or by selecting varieties over years or decades to produce desired traits.

Underlying this unfamiliarity with the science, I believe, was *the unfounded fear that we were about to take away the public's right to decide* whether or not to eat transgenic tomatoes created using the yeast genes: longer shelf life was, to them, not the issue. It is not an uncommon fear that underpins much of the contentious public discussion of the crops that are developed by modern plant biotechnology.

In fact, this research illustrated a very important fact– and one that I pointed out in my own posting to Facebook – yes, I (or rather, someone on my behalf) actually posted a comment! The basic research reported in the article used a yeast gene to elucidate the pathway of ripening and softening; and the investigators could use the discovery to rapidly develop a new product. The public can and will decide whether or not to support a rapid development program to produce long-lasting tomatoes via a transgenic approach OR be content to take a much longer, more expensive conventional breeding approach to select for longer-lasting tomatoes that express a cognate gene that provides a similar phenotype. Time to product is an advantage of genetic engineering.

The fundamental science that NIFA funded in this example is agnostic concerning the eventual societal decision about the technology used to create a long shelf-life tomato.

In this session you will hear about progress on projects that target development of foods and crops with traits that could not be developed through classical or advanced breeding approaches. Many projects conducted by these and other colleagues are predicted to have significant positive impacts on human health and well being, on the environment, on energy independence, or other benefits. Market analyses may even validate the scientist's claims. These new traits, too, are the subject of suspicion for a vocal segment of our society and will by their voice, or by the current regulatory frameworks that determine if and when new products will be approved, delay the approval and distribution under current regulatory frameworks.

In the end, the decision is still made by the public – and the marketplace. And that is where it should stay – this is not a decision that can or should be made at the lab bench.

Certainly there have been notable success, and more are *en route* to your local market: However, except for unique examples, namely virus resistant papaya and virus resistant plum, products have been developed and delivered ONLY by successful private sector companies. The lack of public involvement in using genetic engineering or advanced breeding tools to develop new products is a change from the history of agriculture, and is of concern to many in this room. This concern is being heard in the USDA, at the highest levels, and encouraging discussions are in progress.

For more than 20 years we in the academic science community and in the private sector have struggled with how to deal with the lack of acceptance of agriculture biotechnology, and the challenge of bringing new biotech products to market. I don't have a magic bullet or key to break the lock that confines the technology. One thing is clear: We need to take the mystique out of science, especially biotechnology, and allow the public to see our research for what it is – solid, unbiased, and safe. How do we bring scientific research back into the societal conversation where it belongs? We as scientists must forge a relationship with the public. Often suggested, poorly implemented, however. As scientists we have the unique opportunity to explain complex research and inform – not co-opt – the conversation.

Some of you are involved in the dialogue: I urge you to remain involved. I suspect, however, that until or unless there are mechanisms to bring the

products of your discovery through the approval process and to the public, your voice, your enthusiasm may be muted. I hope that you will look beyond self-interest, beyond the current difficulties and delays in product approval, and continue to be a voice for science – outside of the lab, in the public venues. Our discussions must not be about us, about how great is our science. It is about them, those that we would serve, their environment, their hopes.

If we don't, the next time the crest of the wave or the new snows, nanotechnology, or third generation biofuels, or other technology bring us down, it will assuredly be on a rock or into a tree.

This administration, including the leadership of the USDA, knows the importance of science in innovation and moving from innovation to entrepreneurship and economic growth. This extends to the Office of Science and Technology Policy and the Office of Management of Budget. There is a great deal of discussion underway about how to energize and facilitate investments that lead to rural prosperity – much of this will come through agriculture, and green innovation. Many of you in this room can contribute to this goal – I hope you will choose to do so. My pledge is that NIFA and other parts of the USDA will be important players/supporters of the process to achieve the goal.

Thank you for your attention and I look forward to speaking with many of you in the year ahead.

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